
The Taxonomic structu

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Deals with an arrangement of individual organisms in ranks basically from species to kingdom

The process of classification

With all approaches to classification, the process of classification can be viewed as a series of operations

- It usually involves two separate operations:
  - **Grouping**
  - **Ranking**

Grouping involves three specific operations:

- First one must select characters/features of organisms to use in assessing the similarities and differences
- The second operation in grouping involves describing and/or measuring these characters. Here the character states, which are actually used for the purposes of taxonomic comparison and evaluation, are dealt with.
- The third operation in grouping is to

These comparisons can be made in different ways:

- A formal method can be used (computer programmes are employed) – in **phenetics** and **cladistics**.
- The comparison can be done more intuitively in traditional approaches – **artificial, natural** and **phyletic**.

In some situations:

- Particular character states will be regarded as having more importance than others – **artificial** and **cladistics**.
- Whereas in other situations all the character states will be accorded the same or equal importance –**phenetics**, **phyletic** and **natural systems of classifications.**

Ranking

- **Ranking involves two specific operations:**
- All the character states of the groups are examined and some are selected for use.
  - The character states must be the same and even include all of those used for grouping but actually not all of them are used for ranking.
- Other characters also might be selected, consideration that were not used for the grouping.
- The second step is that those selected character states of the group are evaluated in terms of the categories available for use in the taxonomic hierarch.

ϖ These differences in approach to comparison of character states are important disagreement

Grouping – involves

Selection Description & measurement Comparison

Individual organisms →→ Characters →→Character states →→→→ taxa

(all aspects)

- **Ranking**

Selection Evaluation

Taxa→→→→→→Character states→→→→→→→→→→→→categories

(all character states)

Fig. 1. Representation of the two primary operations of classification

- In the decades following Linnaeus, taxonomist began to group organisms into larger, more inclusive categories such types of biological classification is known as **taxonomic hierarchy**.
- An arrangement of taxa into an ascending series of ever – increasing inclusiveness forms what is known as a **hierarchical system of classification**.
- In a hierarchical system, we start at **the bottom with individuals** and end up at **the top with one all-embracing taxon.**

- The need for taxonomic hierarchy (classification) is to simplify a clear understanding of organisms b/c of they are numerous. As an aid to memory
  - Insect=7,510,000 - Protozoa=30800
  - Higher plants=284,000 - animals=281,000
  - Fungi=69,000 - Algae=26,900
  - Bacteria=4800 -Virus=1000
- Has a biological basis to show evolutionary r/ships

- When species are compared with one another, it is found convenient to group together those with most features in common are grouped into larger, more inclusive taxa that are called **genera**.
- Genera that have more features in common are in their turn grouped like wise into yet more inclusive taxa called **families**. Families into **Orders**, etc.

7 taxonomic categories:

Kingdom largest, most general group

Phylum called a division with plants

Class

Order

Family

Genus

Species smallest, most specific group

- **Species** is the basic units of **classification** and **evolution**. b/c
  - **Species can interbreed with each other and undergo modification &**
  - **It is the fundamental categories in taxonomic hierarchy**

Classification ranks and their standard endings in plants.

Category	Ending (Naming) in scientific world	Examples
Domain		Archea,Eubacteria, Eukaryote
Kingdom	Animalia/Plantae/ Fungi	Animalia/ Plantae/ Fungi
Phylum	-a	Magnoliophyta
Class	-ae	Angiospermae
Order	-ales	**CELASTRALES**
Family	-aceae	CELASTRACEAE
Genus	The normal name that you give a plant	*Catha*
species	This is the level that defines an individual plant.	*Catha edulis*

Concept of kingdom

- There was different approaches to classify organisms at kingdom level.

The Two- Kingdom Concept/Approach.

- This concept existed before the 1950s. This concept was based on dividing all organisms into two kingdoms: Linnaeus recognized only two kingdoms of living things:

  Kingdom Plantae

  Kingdom Animalia

- The differences were based, mainly on **cell wall present vs. cell wall absent.**
- Thus, all organisms that possessed any kind of cell wall were placed in the Kingdom **Plantae**. The Kingdom Plantae was thus composed of:
  - **Bacteria**
  - **Fungi**
  - **Algae**
  - **Land Plants**

ϖSome naturalists later questioned this approach, especially after the invention of the **Electron Microscope in the 1950s.**

The 3-kingdom approaches

Ernest Haeckle (1866)

- Organisms were classified into three Kingdoms:
  - **Plantae**
  - **Animalia** and
  - a third **Kingdom Protista** for the intermediates, like some algae and protozoa (**dinoflagellates**), which behave

Four kingdom approach

- **Copland (1956),** The studies with electron microscope made it clear that bacteria and related organisms have a different nuclear structure as compared to others.
- These are the prokaryotes
- He Introduced the kingdom-Monera
- Fungi continued to remain with Plantae in this system.

    1. Kingdom plantea
    2. Kingdom animalea
    3. Kingdom protista
    4. Kingdom monera

The Five-Kingdom Concept/Approach

- After the invention of the **Electron Microscope, especially Transmission Electron Microscope (TEM),** some biologists were able to investigate the composition of the cell using TEM, which has a very high-resolution power (**up to x100, 000**).
- The electron microscope revealed that there are differences in the composition of the cells of few groups of organisms that were considered members of the **Kingdom Plantae**, and some members of the **Kingdom Animalia**.

Five kingdom approach

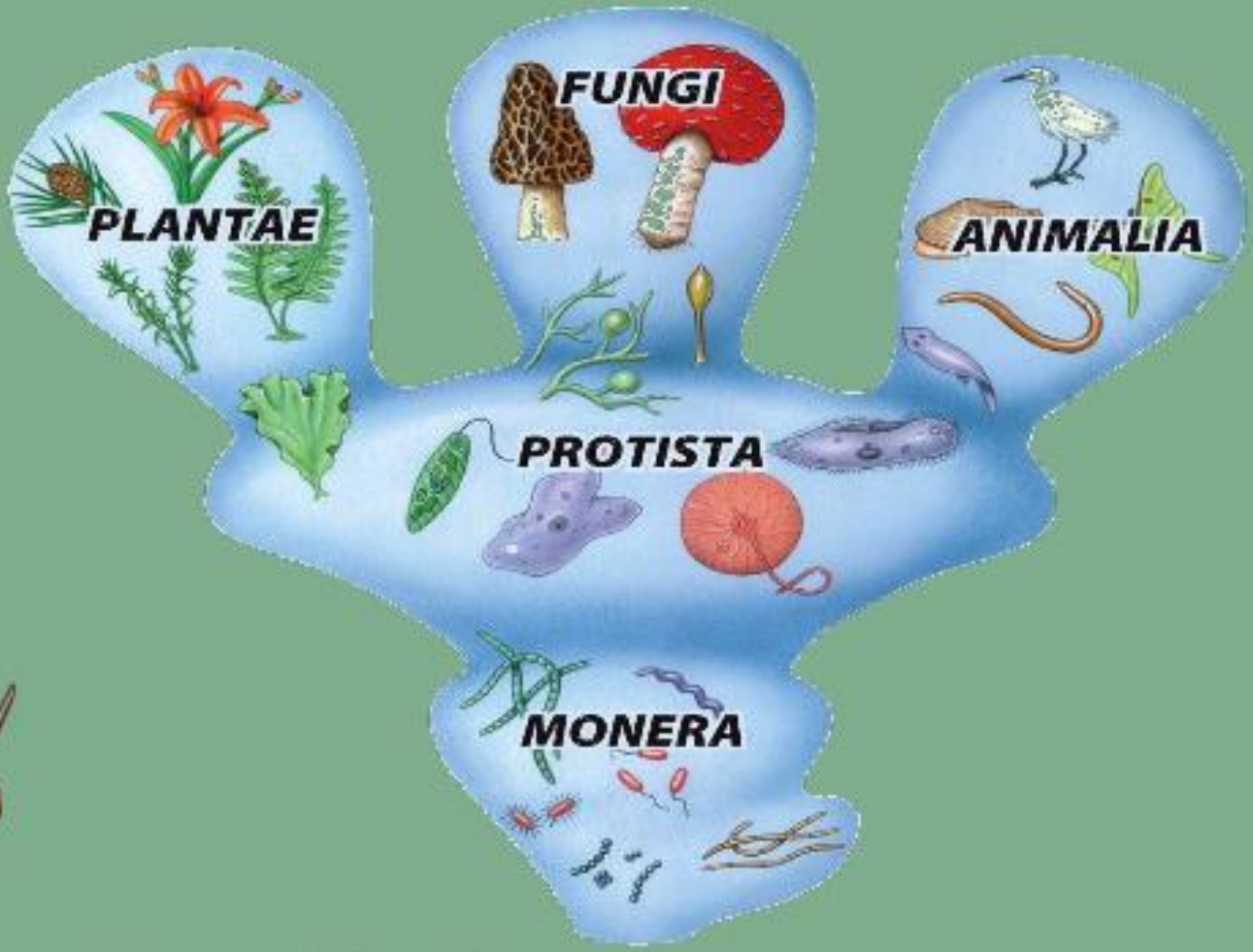
- 1967, Robert Whittaker introduced the five-kingdom classification system.

♣He created a separate group for fungi

The primary criterion for classification here were:

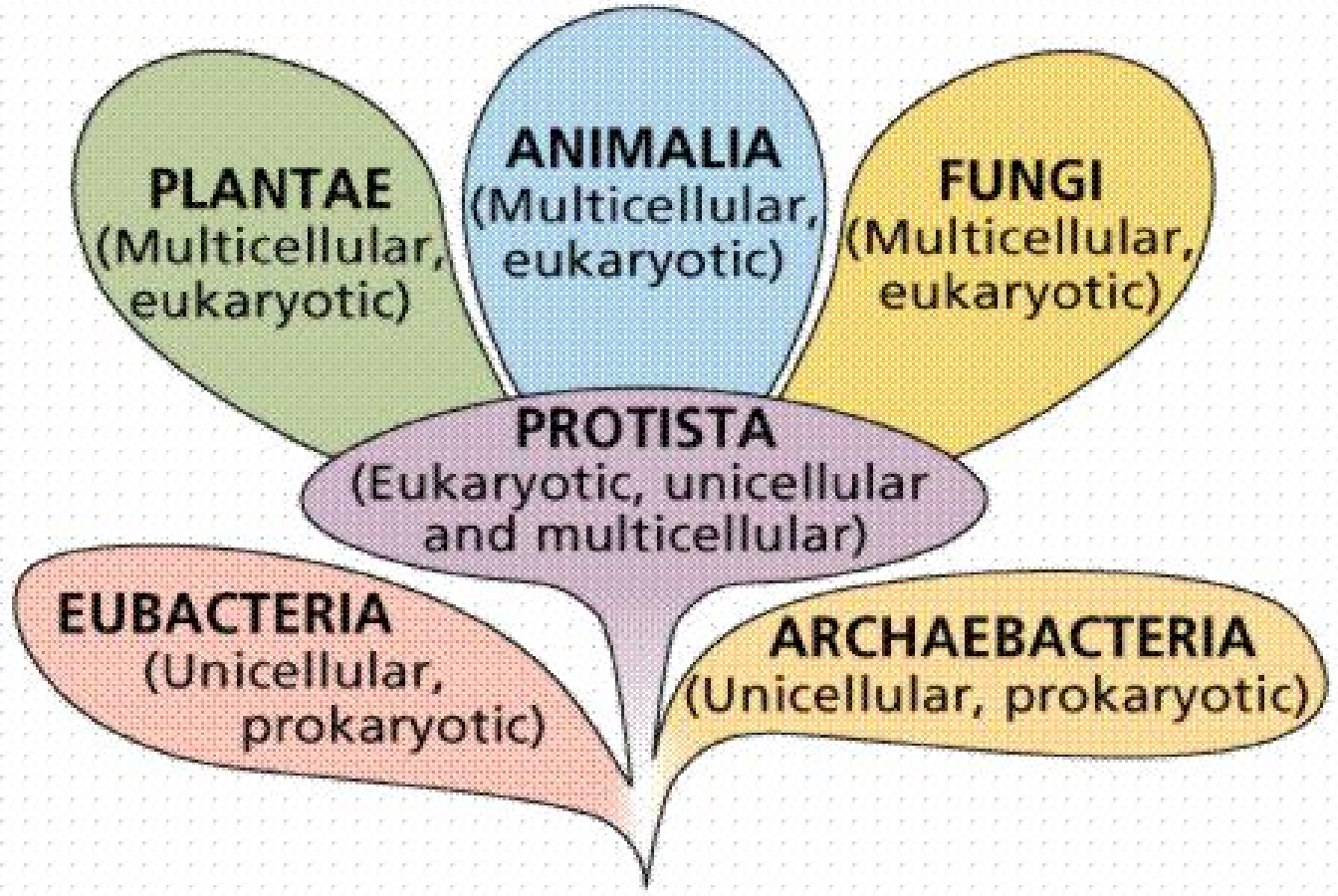
- Complexity of Cell structure
- Modes of nutrition
- Complexity of organisms
- Life style
- Phylogenetic relationships

Five Kingdoms



Six-Kingdom of life

Gray & Doolittle (1982) on the basis of gene sequences



Three Domain System

- Proposed by **Carl Woese (1990)**
  Classified on the basis of 16S rRNA

- Living things fall into three broad groups called domains.
  - Domain Archaea (archaebacteria)
  - Domain Bacteria (eubacteria)
  - Domain Eukarya (eukaryotes)-true nuclei with linear chromosomes and membrane—bound organelles.
  - This Includes Protista, Plantae, Fungi, and Animalia.

Species Concept

What defines a species?

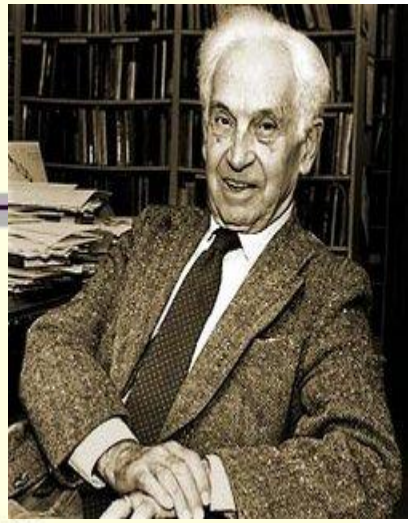
Species Concepts

Defining “a species” is not as simple as you might hope

There are many different “species concepts”.

- What is a species? Various definitions of the species:
- The **species** is a basic unit of classification.
- The **species** is the fundamental category of the taxonomic hierarchy.
- **Species** are the building bricks in biological classification from which concepts of the higher and lower groups are developed.
- The **species** is the lowest category in the hierarchy that is consistently used and recognised by all peoples of the world.
- **Species** are the basic units of evolutionary classification.

- **Biological Species Concept**
  - a reproductively isolated population
- Mayr (1942):
  - "***Species are groups of interbreeding natural populations that are reproductively isolated from other such groups.***"
    - Historically, the most widely used concept among **ecologists**



ϖThe biological sp is defined as individual members of which are able to exchange genes successfully (to cross freely) & produce fertile and viable progeny.

¬The inability to exchange genes freely and

Biological Species Concept

- While a strong delimitation, the biological species concept continues to face discussion for the following reasons…..
  - Some organisms reproduce through binary fission, fragmentation, regeneration, budding, or other asexual means
  - Mating may be possible, yet hybrids sterile or unable to produce offspring successfully
  - Difficult to apply for fossil/ ext

Other Weaknesses?

Problems with the BSC:

1. Not applicable to asexual species

2. Reproductive isolation is often incomplete

- hybridization is common among many groups (waterfowl, terrestrial plants, freshwater fishes).

3. Multidimensional concept difficult to verify

- how do we assess the “potential to interbreed”? Determining potential gene exchange in the laboratory/ in nature whether or not a sp. is actually interbreeding is often difficult.

Morphological/Typological Species Concept

- A set of distinct physical features of a population of animals which sets it apart from others
- May be applied to [illegible] sexes

- A group of organisms
- A group of organisms in which individuals are members of the sp. if they sufficiently conform to certain fixed properties.

Strengths?

Weaknesses?

Phylogenetic/Evolutionary Species Concept

- Smallest set of organisms that share an ancestor and can be distinguished from other such sets
- Subspecies not recognized
  - Strengths: considers ancestry, genetic similarity, evolutionary process
  - Weaknesses: does not consider reproductive habits

Ecological Species Concept

- Focus of species characterization is on similarity of niche and ecological role
- Sp. is a set of organisms that adapt to a particular set of resources called niche in envt. Or exploiting the same ecological niche
  - Strengths: considers species' role in an ecosystem
  - Weaknesses: geographically widespread populations that don't actually interbreed may be considered the same species

Genetic Species Concept

- This is based on similarities of DNA of individuals or populations.

Assignment

Qn1. Which species definition is the best & why?

Qn2. Enumerate strength and weakness of each sp. concept

Quiz

1. In taxonomy, each level of classification is referred to as a (an) _____
2. Characteristics that appear in recent parts of a lineage but not in its older members are called ___
   a. Taxons
   b. Derived characters
   c. Cladograms
   d. Genes
3. The group of organisms that can be larger than a kingdom is called a ___
   a. domain
   b. species
   c. phylum
   d. class
4. List in order from smallest to largest the